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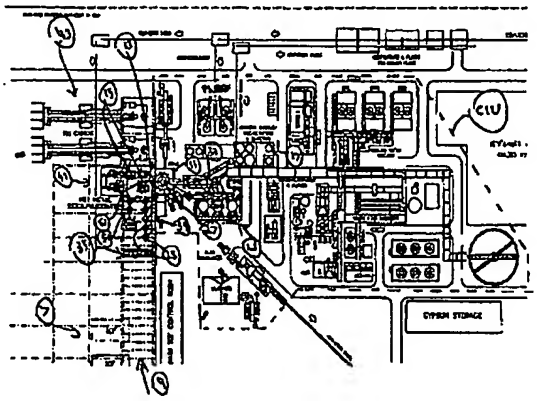
(54) USINE DE PRODUCTION INTEGREE DE FER ET D'ACIER
(54) COMBINED IRONMAKING AND STEELMAKING PLANT

(57)

A combined ironmaking and steelmaking plant is disclosed. The plant includes a direct smelting ironmaking plant that includes an ironmaking vessel and a steelmaking plant for producing molten steel from molten iron from the iron making plant. The steelmaking plant includes a steelmaking vessel such as a BOF. The plant also includes a plurality of ladles for molten iron and a transfer means for transferring the ladles between (i) an operative position at the ironmaking vessel for receiving molten iron from the ironmaking vessel and (ii) an operative position at the steelmaking vessel for discharging molten iron directly into the steelmaking vessel. The transfer means links together the ironmaking vessel and the steelmaking vessel. The transfer means includes a transfer crane for supporting the ladles and a transfer crane runway that defines a path of movement for the crane.



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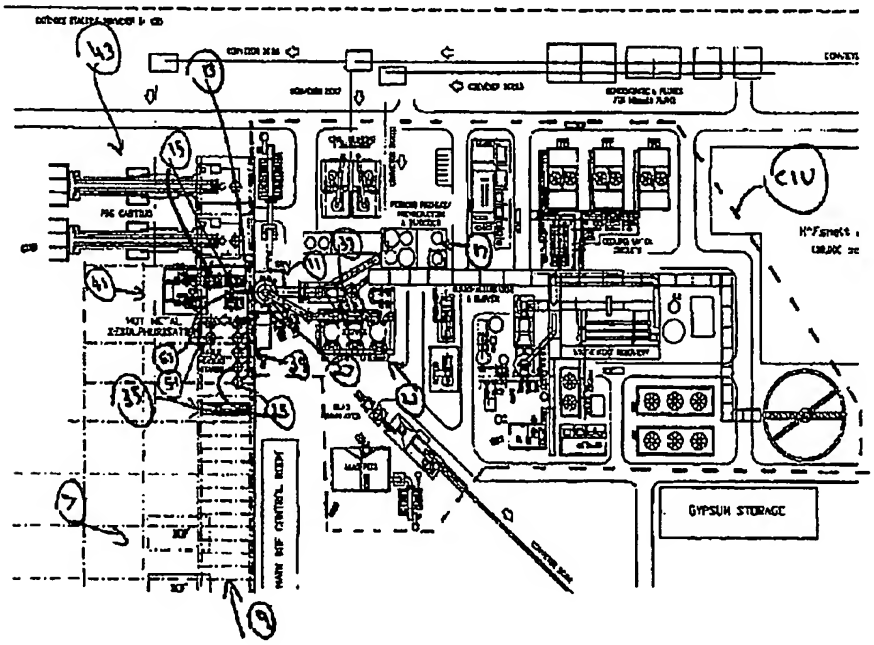

(57) Abrégé/Abstract:
A combined ironmaking and steelmaking plant is disclosed. The plant includes a direct smelting ironmaking plant that includes an ironmaking vessel and a steelmaking plant for producing molten steel from molten iron from the iron making plant. The steelmaking plant includes a steelmaking vessel such as a BOF. The plant also includes a plurality of ladles for molten iron and a transfer means for transferring the ladles between (i) an operative position at the ironmaking vessel for receiving molten iron from the ironmaking vessel and (ii) an operative position at the steelmaking vessel for discharging molten iron directly into the steelmaking vessel. The transfer means links together the ironmaking vessel and the steelmaking vessel. The transfer means includes a transfer crane for supporting the ladles and a transfer crane runway that defines a path of movement for the crane.

ABSTRACT

A combined ironmaking and steelmaking plant is disclosed. The plant includes a direct smelting ironmaking plant that includes an ironmaking vessel and a steelmaking plant for producing molten steel from molten iron from the iron making plant. The steelmaking plant includes a steelmaking vessel such as a BOF. The plant also includes a plurality of ladles for molten iron, and a transfer means for transferring the ladles between (i) an operative position at the ironmaking vessel for receiving molten iron from the ironmaking vessel and (ii) an operative position at the steelmaking vessel for discharging molten iron directly into the steelmaking vessel. The transfer means links together the ironmaking vessel and the steelmaking vessel. The transfer means includes a transfer crane for supporting the ladles and a transfer crane runway that defines a path of movement for the crane.

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COMBINED IRONMAKING AND STEELMAKING PLANT

TECHNICAL FIELD

The present invention relates to a combined ironmaking and steelmaking plant for producing molten steel from an iron-bearing metalliferous feed material such as ores, partly reduced ores and iron-containing waste streams.

The present invention relates particularly, although by no means exclusively, to a combined ironmaking and steelmaking plant for producing molten steel by a process that includes producing molten iron in an ironmaking vessel by a direct smelting process, more particularly a molten bath-based direct smelting process, and thereafter producing steel from the molten iron in a steelmaking vessel by a basic oxygen process.

The term "direct smelting process" is understood herein to mean a thermal process for producing molten iron directly from an iron-bearing metalliferous feed material such as ores, partly reduced ores and iron-containing waste streams, wherein chemical reactions reduce the metalliferous feed material to molten iron.

The HIsmelt process is a molten bath-based direct smelting process for producing molten iron. The HIsmelt process is described, by way of example, in International Application PCT/AU96/00197 (WO 96/31627) in the name of the applicant. The HIsmelt process is an alternative process to the conventional blast furnace-based direct smelting process for producing molten iron.

The HIsmelt process has been tested successfully at development plant level and a related company of the applicant is now constructing a commercial plant at

Kwinana, Western Australia.

The HIsmelt process, and other molten bath-based direct smelting processes that have been proposed in the literature, enable large quantities of molten iron to be produced by direct smelting in compact vessels.

The basic oxygen process is a commonly used process for making steel. The process enables large quantities of molten steel to be produced from molten iron in compact vessels.

The present invention is based on the realisation that with careful design the above-described compact direct smelting and steelmaking vessels make it possible to produce molten iron and thereafter steel using a quite different plant layout to that of traditional integrated steelworks.

In traditional integrated steelworks, ironmaking and steelmaking are essentially separate operations and ironmaking plants and steelmaking plants are spaced apart by relatively large distances within the boundaries of integrated steelworks. Molten iron is transferred from ironmaking to steelmaking plants in purpose-built torpedo cars that run on rail tracks between the plants. When the torpedo cars reach steelmaking plants the molten iron is discharged into ladles, and the ladles transport molten iron as required within the steelmaking plants. Depending on the circumstances, molten iron may be treated by being desulphurised and/or dephosphorised in the ladles before the ladles are moved to steelmaking vessels and the treated iron is discharged from the ladles into the vessels and processed to produce steel.

The above-described multiple handling of each batch of molten iron and the long transfer distances

between ironmaking and steelmaking plants are disadvantages of traditional integrated steelworks. The step of transferring batches of molten iron from one receptacle to another introduces time delays and inevitably results in temperature losses in the molten metal. The temperature losses are an important consideration given that there is a relatively small temperature window between the tapping temperature for molten iron and the minimum feed temperature for steelmaking vessels.

In addition, the use of torpedo cars represents a substantial investment in terms of the cars themselves, the rail networks for the cars, the locomotives to move the cars, the plant and equipment that is required to clean, repair, and re-line the cars, and the plant and equipment that is required to preheat the cars prior to receiving a batch of molten iron.

The plant layout of the combined ironmaking and steelmaking plant of the present invention avoids the above-described disadvantages of traditional integrated steelworks.

The plant layout of the present invention is suitable particularly, although not exclusively, for a greenfield site.

DISCLOSURE OF THE INVENTION

According to the present invention there is provided a combined ironmaking and steelmaking plant including:

(a) a direct smelting ironmaking plant for producing molten iron from an iron-bearing metalliferous feed material such as ores, partly reduced ores and iron-containing waste streams, the ironmaking plant including an

ironmaking vessel;

(b) a steelmaking plant for receiving molten iron and producing molten steel from molten iron, the steelmaking plant including a steelmaking vessel;

(c) at least one receptacle for receiving and holding molten iron from the ironmaking vessel and for discharging molten iron directly into the steelmaking vessel; and

(d) a transfer means for transferring the receptacle between (i) an operative position at the ironmaking vessel at which the receptacle can receive molten iron from the ironmaking vessel and (ii) an operative position at the steelmaking vessel at which the receptacle can discharge molten iron directly into the steelmaking vessel and thereby links together the ironmaking vessel and the steelmaking vessel, the transfer means including a transfer crane for supporting the receptacle and a transfer crane runway that defines a path of movement for the crane.

With the above-described combined plant, the ironmaking vessel can transfer molten iron directly into the receptacle when the receptacle is positioned at the operative position at the ironmaking vessel.

In addition, with the above-described combined plant, the ironmaking vessel, the steelmaking vessel and the transfer means are positioned in relation to each other so that a receptacle containing molten iron can be carried by the transfer crane from the operative position at the ironmaking vessel along the transfer crane runway to the operative position at the steelmaking vessel and molten iron can be discharged directly from the receptacle into the steelmaking vessel.

The above-described combined plant is centred on the transfer means and the relative positions of the transfer means, the ironmaking vessel, and the steelmaking vessel that links together the operative positions of the receptacle at the ironmaking vessel and the steelmaking vessel and makes it possible to use one receptacle only for transferring a given batch of molten iron the whole distance from the ironmaking vessel to the steelmaking vessel by means of the transfer means.

Preferably the ironmaking vessel is adapted to discharge molten iron continuously from the vessel.

With such an arrangement, preferably the combined plant includes at least two receptacles and the ironmaking plant includes a means for selectively supplying molten iron discharged continuously from the ironmaking vessel into one or other of the receptacles at the operative position at the ironmaking plant.

Preferably the operative position at the steelmaking vessel is an elevated position in relation to the operative position at the ironmaking vessel.

Preferably the combined plant further includes a molten iron treatment plant for treating molten iron positioned in relation to the transfer crane runway so that a receptacle containing molten iron can be transferred from the operative position at the ironmaking vessel to an operative position at the molten iron treatment plant, thereafter the molten iron can be treated at the molten iron treatment plant, and the receptacle means can then be carried by the transfer crane along the transfer crane runway to the operative position at the steelmaking vessel and the treated molten iron can be discharged directly from the receptacle into the steelmaking vessel.

Preferably the ironmaking vessel and the molten iron treatment plant are on opposite sides of the transfer runway.

Preferably the operative positions at the ironmaking vessel and the molten iron treatment plant are directly across from one another.

Preferably the transfer means includes a transfer car or other suitable molten iron transfer means for supporting and transferring the receptacle means containing molten iron from the operative position at the ironmaking vessel to the operative position at the molten iron treatment plant. This is a convenient arrangement for transferring molten iron from the ironmaking vessel to the molten iron treatment unit.

Preferably the transfer means includes a rail-mounted transfer car for supporting and transferring the receptacle means containing molten iron from the operative position at the ironmaking vessel to the operative position at the molten iron treatment plant.

Preferably the transfer car and the transfer crane are adapted to operate independently of each other.

Preferably the molten iron treatment plant is a desulphurisation plant that is adapted to desulphurise molten iron in the receptacle means in situ on the molten iron transfer means.

Preferably the combined plant further includes a molten iron solidification plant for casting molten iron into pigs or other moulds or for quenching molten iron into granules or for otherwise forming solid iron positioned in relation to the transfer crane runway so that a receptacle containing molten iron can be carried by the transfer crane

along the transfer crane runway to an operative position at the solidification plant and molten iron can be discharged from the receptacle into the solidification plant.

Preferably the operative position at the steelmaking vessel and the operative position at the solidification plant are at opposite ends of the transfer crane runway.

Preferably the combined plant further includes a receptacle heating stand positioned in relation to the transfer crane runway so that an empty receptacle can be heated at the the receptacle heating stand and thereafter carried by the transfer crane along the transfer crane runway to the operative position at the ironmaking vessel to be filled with molten iron.

Preferably the transfer crane runway is straight.

Preferably the direct smelting ironmaking plant is adapted to produce molten iron by a molten bath-based direct smelting process.

Preferably molten bath-based direct smelting process is the HIsmelt process.

Preferably the receptacle is a ladle.

Preferably the transfer crane and the ladle are adapted to allow for tilting a ladle containing molten iron towards the steelmaking vessel so that molten iron can be discharged from the ladle while supported by the transfer crane.

Preferably the steelmaking vessel is adapted to tilt towards a ladle containing molten iron when the ladle is at the operative position of the steelmaking vessel to

facilitate discharging of molten iron into the steelmaking vessel.

According to the present invention there is also provided a method of making steel in the combined ironmaking and steelmaking plant described above which includes making molten iron in the direct smelting ironmaking plant, discharging molten iron from the ironmaking vessel into the receptacle at the operative position of the ironmaking plant, transferring the receptacle containing the molten iron to the steelmaking plant using the transfer means, discharging molten iron from the receptacle into the steelmaking vessel, and making steel from the molten iron in the steelmaking plant.

Preferably the method further includes transferring the receptacle containing the molten iron from the ironmaking plant to the molten iron treatment plant using the transfer means, treating the molten iron at the molten iron treatment plant, and thereafter transferring the receptacle containing the treated molten iron to the steelmaking plant.

Preferably the method includes continuously discharging molten iron from the ironmaking vessel into one of two receptacles at operative positions of the ironmaking plant.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is described in more detail hereinafter with reference to the accompanying drawings, of which:

Figure 1 is a layout of one embodiment of a combined ironmaking and steelmaking plant in accordance with the present invention, and

Figure 2 is a detailed view of one part of the layout shown in Figure 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The combined ironmaking and steelmaking plant shown in the figures includes:

(a) an ironmaking plant enclosed within the dashed line marked CIU on the figure for producing molten iron in accordance with the HIsmelt process in a fixed, compact direct smelting vessel 11;

(b) ladles 15 or other suitable receptacles for receiving, holding, and discharging molten iron produced by the ironmaking plant,

(c) a steelmaking plant that includes two basic oxygen furnaces (BOF) 7 for producing steel from the molten iron in accordance with the basic oxygen process,

(d) a molten iron treatment plant 41 in the form of a desulphurisation plant for desulphurising molten iron in a ladle 15; and

(e) a transfer means for tranferring ladles 15 containing molten iron from the direct smelting vessel 11 to the desulphurisation plant 41 and thereafter transferring ladles containing desulphurised molten iron to the BOFs 7 and for tipping the ladles to pour molten iron from the ladles into the BOFs 7 at the steelmaking unit.

The combined plant also includes a molten solidification plant in the form of an iron casting plant 43 for casting molten iron into pigs.

The combined plant also includes a pair of ladle heating stands 51 for pre-heating empty ladles prior to moving the ladles to the ironmaking plant CIU to be filled with molten iron.

The transfer means includes (a) rail-mounted transfer cars 55 (shown more clearly in Figure 2 than in Figure 1) that support and transfer ladles 15 filled with molten iron from the direct smelting vessel 11 to the desulphurisation plant 41 and empty ladles 15 to the vessel 11, (b) an overhead transfer crane 35 for lifting and carrying the ladles 15, and (c) a runway 9 that defines a path of movement for the crane 35.

The rail-mounted transfer cars 55 facilitate movement of ladles 15 filled with molten iron across the width of the runway 9 from the direct smelting vessel 11 to the desulphurisation plant 41.

The crane 35 and the runway 9 facilitate movement of the ladles 15 along the length of the runway 9 and across the width of the runway 9.

In addition, the transfer cars 55, the crane 35 and the runway 9 facilitate movement of pre-heated empty ladles 15 from the ladle heating stands 51 to the direct smelting vessel 11.

It is evident from the above and the figures that the paths of movement of the transfer cars 55 across the runway 9 and the crane 35 along the runway 9 intersect. The transfer cars 55 and the crane 35 can move independently of each other and, accordingly, in order to

avoid interference, the crane 35 is adapted to lift ladles 15 well clear of the transfer cars 55.

The steelmaking plant is characterised in that the direct smelting vessel 11, the BOFs 7, the desulphurisation plant 41, the pig casting plant 43, and the ladle heating stands 51 are positioned in relation to the transfer means so that the ladles 15 can be moved by the transfer means to operative positions at the vessel 11, the BOFs 7, the plants 41, 43, and the ladle heating stands 51.

Specifically, the operative position for the ladles 15 at the direct smelting vessel 11 is the position of the ladles 15 in the figures, ie positions at which a pair of the ladles 15 can receive molten iron directly from the vessel 11 via a hot metal launder 13 and a tilter runner assembly 61 (see Figure 2).

The operative position for the ladles 15 at the BOFs 7 is elevated positions at which the ladles 15 can be tilted to pour molten iron in the ladles 15 directly into the BOFs 7.

The operative position for the ladles 15 at the desulphurisation plant 41 is a position at which molten metal can be desulphurised in the ladles 15.

The operative positions for the ladles 15 at the direct smelting vessel 11 and the desulphurisation plant 41 are at the same horizontal level and are directly across from one another so that there is a straight line transfer of the ladles 15 via the transfer cars 55 from the direct smelting vessel 11 to the desulphurisation unit 41.

The operative position for the ladles 15 at the pig casting plant 43 is an elevated position at which the

ladles 15 can be tilted to pour molten iron in the ladles 15 directly into the parallel pig casting lines.

The above-described locations of the direct smelting vessel 11, the steelmaking unit, the desulphurisation plant 41, the pig casting plant 43, and the ladle heating stands 51 in relation to the transfer means, and more particularly in relation to the crane runway 9, greatly facilitates efficient transfer of molten iron as required within the combined plant. In particular, the above-described arrangement minimises the number of ladles 15 and crane operations that are required to transfer molten iron from the direct smelting vessel 11 to the BOFs 7.

The combined plant also includes end tap ladles 25 for receiving and transferring molten iron discharged from the direct smelting vessel 11 via a launder 39 in an end tap of the vessel. The positions of the vessel 11 and the ladles 25 is selected so that the ladles 25 can be lifted and moved by the transfer crane 35 as required to the BOFs 7, the desulphurisation plant 41, and the pig casting plant 43.

The direct smelting vessel 11 is a water-cooled refractory lined vessel that is adapted to contain a molten bath of iron and slag.

The vessel 11 is fitted with a gas injection lance (not shown) for delivering a downwardly directed hot air blast into an upper region of the vessel. In use, the lance receives an oxygen-enriched hot air blast through a hot gas delivery duct 31 that extends from hot gas supply station 21. The hot gas supply station 21 includes a series of hot blast stoves and an oxygen plant to enable an oxygen-enriched air stream to be passed through the hot blast stoves and into the hot blast delivery duct 31.

The vessel 11 is also fitted with solids injection lances 27 that extend downwardly and inwardly through openings (not shown) in the side walls of the vessel for injecting iron ore fines, solid carbonaceous material, and fluxes entrained in an oxygen-deficient carrier gas into the molten bath in the vessel.

Typically, the lances 27 are in 2 groups of lances, with the lances 27 in one group receiving hot iron ore fines supplied via a hot ore injection system and the lances 27 in the other group receiving coal and flux via a carbonaceous material/flux injection system during a smelting operation. The lances 27 in the 2 groups are arranged alternately around the circumference of the vessel.

The hot ore injection system includes a pre-heat/pre-reduction unit 17 for heating and partially reducing the iron ore fines and a hot ore transfer system that includes a series of supply lines (not shown) and a supply of carrier gas (not shown) for transporting the hot ore fines in the supply lines and injecting the hot ore fines into the vessel.

The vessel 11 includes an offgas duct 32 which transports offgas produced in the process away from the vessel 11 to a treatment station 33 where it is cleaned and passed through heat exchangers for preheating the materials fed to the vessel 11.

In a smelting operation in accordance with the HIsmelt process, ore fines, coal, and flux are injected into the molten bath through the lances 27. The coal is devolatilised and thereby produces gas in the molten bath. Carbon partially dissolves in the metal and partially remains as solid carbon. The ore fines are smelted to metal and the smelting reaction generates carbon monoxide.

The gases transported into the metal layer and generated by devolatilisation and smelting reactions produce significant buoyancy uplift of molten metal, solid carbon and slag. Injection of the oxygen-containing gas via the lance post-combusts reaction gases in the upper part of the vessel.

Hot metal produced during a smelting operation is discharged continuously from the vessel 11 into one of two ladles 15 at the operative position of the vessel 11. The molten iron is discharged into a ladle 15 through a metal tapping system that includes the forehearth (not shown) and hot metal launder 13 connected to the forehearth and the tilter runner assembly 61.

The plant includes an end metal tapping system for tapping molten metal from the vessel 11 at the end of a smelting operation out of the lower part of the vessel and transporting that molten metal away from the vessel 11. The end metal tapping system includes a metal end tap hole (not shown) in the vessel and the launder 39 for transferring molten metal discharged from the vessel 11 via the tap hole to the series of ladles 25 at the position shown in the figures.

The BOFs 7, the desulphurisation plant 41, and the pig casting plant 43 are conventional unit operations.

In use of the above-described combined ironmaking and steelmaking plant, molten iron is produced in the direct smelting ironmaking plant CIU and is discharged continuously from the vessel 11 into one of the ladles 15 at the operative position at the vessel 11. When the ladle 15 is full, the tilter runner assembly 61 re-directs the continuous flow of molten iron from the vessel 11 into the other ladle 15 at the operative position of the vessel 11. The full ladle 15 is transferred across the runway 9 by its associated transfer car 55 to the desulphurisation plant 41

and the molten iron is desulphurised in the ladle 15.Thereafter, the ladle 15 containing the desulphurised molten iron is lifted off its associated transfer car 55 and is transferred by the crane 35 along the runway 9 to the operative position of the BOF's. Thereafter, the ladle 15 is tilted and the desulphurised molten iron is discharged into one of the BOF's. Scrap for the BOF is conveniently charged into the BOF from the opposite side thereof. Thereafter, steel is produced in the BOF. After the full ladle 15 has been empied at the BOF, the crane 35 transfers the empty ladle 15 to the ladle heating stands 51 and the ladle 15 is pre-heated as required for subsequent use. When required, the pre-heated empty ladle 15 is transferred by the crane 35 to the empty transfer car 55 at the desulphurisation plant 41. Thereafter, the ladle 15 is transferred by the transfer car 55 into the operative position at the vessel 11 to receive a further charge of molten iron.

Many modifications may be made to the embodiment of the present invention described above without departing from the spirit and scope of the invention.

CLAIMS:

1. A combined ironmaking and steelmaking plant includes:

(a) a direct smelting ironmaking plant for producing molten iron from an iron-bearing metalliferous feed material such as ores, partly reduced ores and iron-containing waste streams, the ironmaking plant including an ironmaking vessel;

(b) a steelmaking plant for receiving molten iron and producing molten steel from molten iron, the steelmaking plant including a steelmaking vessel;

(c) at least one receptacle for receiving and holding molten iron from the ironmaking vessel and for discharging molten iron directly into the steelmaking vessel; and

(d) a transfer means for transferring the receptacle between (i) an operative position at the ironmaking vessel at which the receptacle can receive molten iron from the ironmaking vessel and (ii) an operative position at the steelmaking vessel at which the receptacle can discharge molten iron directly into the steelmaking vessel and thereby links together the ironmaking vessel and the steelmaking vessel, the transfer means including a transfer crane for supporting the receptacle and a transfer crane runway that defines a path of movement for the crane.

2. The combined plant defined in claim 1 wherein the the ironmaking vessel is adapted to discharge molten iron continuously from the vessel.

3. The combined plant defined in claim 2 includes at

least two receptacles and the ironmaking plant includes a means for selectively supplying molten iron discharged continuously from the ironmaking vessel into one or other of the receptacles at the operative position at the ironmaking plant.

4. The combined plant defined in any one of the preceding claims wherein the operative position at the steelmaking vessel is an elevated position in relation to the operative position at the ironmaking vessel.

5. The combined plant defined in any one of the preceding claims further includes a molten iron treatment plant for treating molten iron positioned in relation to the transfer crane runway so that a receptacle containing molten iron can be transferred from the operative position at the ironmaking vessel to an operative position at the molten iron treatment plant, thereafter the molten iron can be treated at the molten iron treatment plant, and the receptacle can then be carried by the transfer crane along the transfer crane runway to the operative position at the steelmaking vessel and the treated molten iron can be discharged directly from the receptacle into the steelmaking vessel.

6. The combined plant defined in claim 5 wherein wherein the ironmaking vessel and the molten iron treatment plant are on opposite sides of the transfer runway.

7. The combined plant defined in claim 6 wherein the operative positions at the ironmaking vessel and the molten iron treatment plant are directly across from one another.

8. The combined plant defined in any one of claims 5 to 7 wherein the transfer means includes a transfer car or other suitable molten iron transfer means for supporting and transferring the receptacle containing molten iron from

the operative position at the ironmaking vessel to the operative position at the molten iron treatment plant.

9. The combined plant defined in claim 8 wherein the transfer means includes a rail-mounted transfer car for supporting and transferring the receptacle means containing molten iron from the operative position at the ironmaking vessel to the operative position at the molten iron treatment plant.

10. The combined plant defined in claim 9 wherein the transfer car and the transfer crane are adapted to operate independently of each other

11. The combined plant defined in any one of claims 5 to 10 wherein the molten iron treatment plant is a desulphurisation plant that is adapted to desulphurise molten iron in the receptacle in situ on the molten iron transfer means.

12. The combined plant defined in any one of the preceding claims further includes a molten iron solidification plant for casting molten iron into pigs or other moulds or for quenching molten iron into granules or for otherwise forming solid iron positioned in relation to the transfer crane runway so that a receptacle containing molten iron can be carried by the transfer crane along the transfer crane runway to an operative position at the solidification plant and molten iron can be discharged from the receptacle into the solidification plant.

13. The combined plant defined in claim 12 wherein the operative position at the steelmaking vessel and the operative position at the solidification plant are at opposite ends of the transfer crane runway.

14. The combined plant defined in any one of the

preceding claims further includes a receptacle heating stand positioned in relation to the transfer crane runway so that an empty receptacle can be heated at the the receptacle heating stand and thereafter carried by the transfer crane along the transfer crane runway to the operative position at the ironmaking vessel to be filled with molten iron.

15. The combined plant defined in any one of the preceding claims wherein the direct smelting ironmaking plant is adapted to produce molten iron by a molten bath-based direct smelting process.

16. The combined plant defined in any one of the preceding claims wherein the receptacle is a ladle.

17. The combined plant defined in claim 16 wherein the transfer crane and the ladle are adapted to allow for tilting a ladle containing molten iron towards the steelmaking vessel so that molten iron can be discharged from the ladle while supported by the transfer crane.

18. The combined plant defined in claim 16 or claim 17 wherein the steelmaking vessel is adapted to tilt towards a ladle containing molten iron when the ladle is at the operative position of the steelmaking vessel to facilitate discharging of molten iron into the steelmaking vessel.

19. A method of making steel in the combined ironmaking and steelmaking plant defined in any one of the preceding claims, includes: making molten iron in the direct smelting ironmaking plant, discharging molten iron from the ironmaking vessel into the receptacle at the operative position of the ironmaking plant, transferring the receptacle containing the molten iron to the steelmaking plant using the transfer means, discharging

molten iron from the receptacle into the steelmaking vessel, and making steel from the molten iron in the steelmaking plant.

20. The method defined in claim 19 further includes transferring the receptacle containing the molten iron from the ironmaking plant to the molten iron treatment plant using the transfer means, treating the molten iron at the molten iron treatment plant, and thereafter transferring the receptacle containing the treated molten iron to the steelmaking plant.

21. The method defined in claim 19 or claim 20 includes continuously discharging molten iron from the ironmaking vessel into one of two receptacles at operative positions of the ironmaking plant.

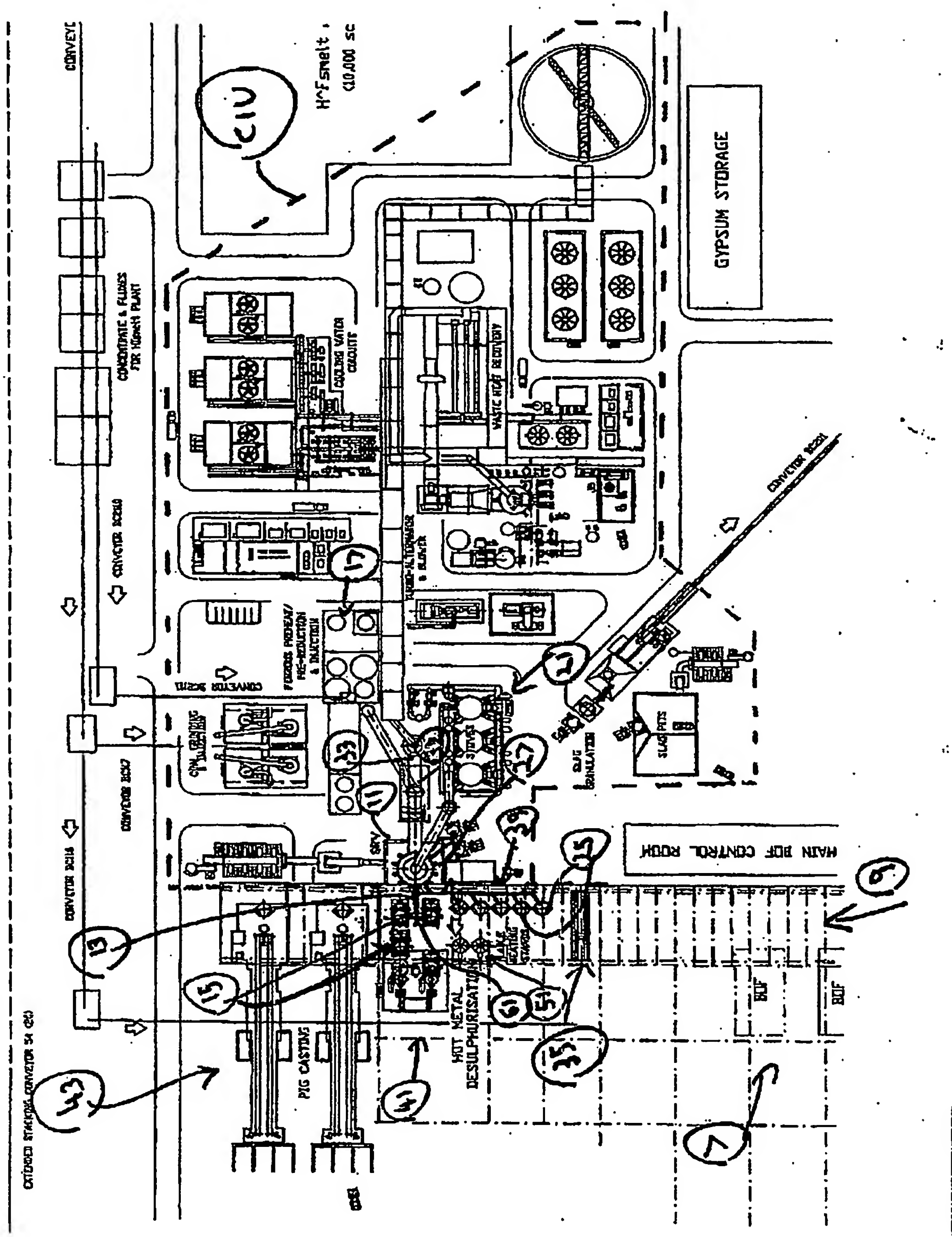
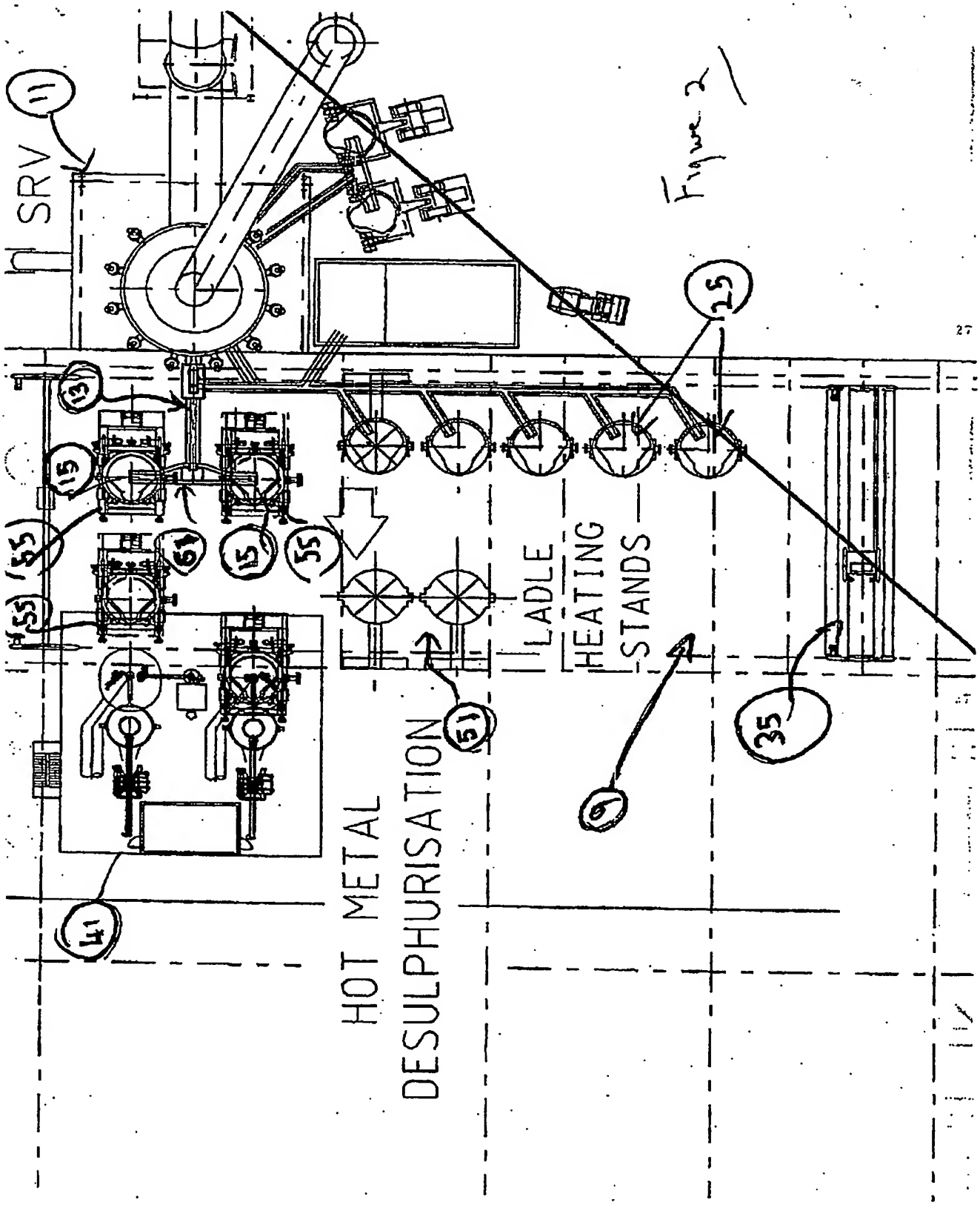

GYPSUM STORAGE
MAIN BOF CONTROL ROOM
PIG CASTING
HOT METAL DESULPHURISATION
SLAG PITS
WASTE HEAT RECOVERY
COOLING WATER CIRCUITS
CONVEYOR

Figure 1


SRV
11
13
15
55
61
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35
6
31
HOT METAL
DESULPHURISATION
LADLE
HEATING
STANDS

Figure 2